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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/501,114	02/10/2000	Yonhua Tzeng	A029 1080	3416

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EXAMINER
MARKHAM, WESLEY D

ART UNIT	PAPER NUMBER
1762	11

DATE MAILED: 06/27/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/501,114	Applicant(s) TZENG, YONHUA	
	Examin r Wesley D Markham	Art Unit 1762	

-- Th MAILING DATE of this communication app ars on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *26 April 2002* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,3 and 5-18* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,3 and 5-18* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *8 and 10* .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on March 4, 2002 has been entered.

Response to Amendment

2. Acknowledgement is made of applicant's amendment B, filed as paper #6 on March 4, 2002, in which the specification of the instant application was amended, and Claims 1, 11, and 13 were amended. Claims 1, 3, and 5 – 18 are currently pending in U.S. Application Serial No. 09/501,114, and an Office Action on the merits follows.

Drawings

3. This application has been filed with informal drawings which are acceptable for examination purposes only. Formal drawings will be required when the application is allowed.

Specification

4. The objection to the specification, set forth in paragraph 3 of the final rejection (paper #5, mailed on January 3, 2002), is withdrawn in light of applicant's amendment B.

Claim Objections

5. Claims 13 and 15 are objected to because of the following informalities:

   - Claim 13 – The word "carboncontaining" in line 12 of Claim 13 appears to contain a typographical error. The applicant is suggested to amend the word to read either "carbon containing" or "carbon-containing".
   - Claim 15 – The phrase, "...between about 0.5 wt.% and about 99.5%" appears to contain a typographical error. The applicant is suggested to amend the phrase to read, "...between about 0.5 wt.% and about 99.5 wt.%".

Appropriate correction is required.

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

7. The rejection of Claims 1, 3, and 5 – 18 under 35 U.S.C. 103(a) as being unpatentable over various combinations of Idemitsu Petrochem Co (JP 05-247651 A), Robson et al. (USPN 5,874,014), Glesener et al. (USPN 5,381,755), and Aida (USPN 5,225,275), set forth in paragraphs 12 – 18 of the final rejection (paper #5), is withdrawn in light of applicant's amendment B and associated remarks. Specifically, amended independent Claims 1 and 13 now require that a liquid precursor substantially free of water be introduced into the reaction chamber in the absence of a gas stream. The aforementioned combination of references does not teach or render obvious these limitations.

8. Claims 1, 3, 5 – 7, and 9 – 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Miyanaga et al. (USPN 5,626,922) in view of Senateur et al. (WO 95/02711) and Pryor (USPN 5,236,545). Please note that the Senateur et al. document is in French, but the English language equivalent (i.e., 371) document (i.e., USPN 5,945,162) is being provided as an effective English language translation.

9. Regarding independent Claim 1, Miyanaga et al. teach a method of forming a diamond film (Col.3, line 11), the method comprising disposing a substrate in a reaction chamber (Figure 1 and Col.5, lines 5 – 22), introducing a liquid precursor (e.g., methanol, ethanol, etc.) into an inlet of the reaction chamber (Col.5, lines 39 – 50), and subjecting the precursor to a plasma under conditions effective to disassociate the precursor and promote the growth of the film on the substrate

(Col.5, lines 50 – 67). Further, nothing in Miyanaga et al. suggests that water should be part of the liquid precursor mixture, as Miyanaga et al. simply list ethanol and methanol as suitable liquid precursor compounds (Col.5, lines 47 – 48). Thus, the liquid precursor(s) of Miyanaga et al. is/are substantially free of water. Miyanaga et al. do not explicitly teach that (1) the liquid precursor is introduced in the absence of a gas stream, (2) the liquid precursor contains methanol and at least one carbon containing compound having a carbon to oxygen ratio greater than one, and (3) the liquid precursor is vaporized prior to subjection to a plasma. However, Miyanaga et al. do desire to deposit the film from liquid precursors such as methanol and ethanol in a plasma CVD process (Col.5). Senateur et al. teach a method for introducing liquid precursors into a chemical vapor deposition chamber (Abstract). According to the method of Senateur et al., liquid precursor droplets having a perfectly controlled and duplicable volume are injected into the deposition chamber in the absence of a gas stream (i.e., through an inlet), are evaporated (i.e., vaporized) due to the temperature and pressure conditions within the chamber, and are conveyed to the substrate where CVD occurs, possibly with plasma activation (see Figure 2 and pages 7 – 8 of Senateur et al.). Further, Senateur et al. teach that their deposition process / device is applicable to any liquid precursor (page 5, lines 25 – 28). In addition, Senateur et al. teach that their process has a number of advantages over other CVD processes, such as (1) eliminating the problems that arise from utilizing a carrier gas to convey vaporized liquid precursors to the deposition chamber (page 2), (2) maintaining the liquid precursor under the pressure of a neutral gas that may

be very pure, (3) accurately regulating the amount of precursors injected, and (4) assuring stability in the deposition process over time (pages 8 – 9). Therefore, it would have been obvious to one of ordinary skill in the art to utilize the deposition process / device of Senateur et al. to deposit the diamond film of Miyanaga et al. with the reasonable expectation of (1) success, as Miyanaga et al. desire to deposit the film from liquid precursors in a plasma CVD process, and Senateur et al. teach that their process is applicable to any liquid precursor and can include plasma activation in the vicinity of the substrate, and (2) obtaining the benefits of the process of Senateur et al., such as eliminating the problems that arise from utilizing a carrier gas to convey vaporized liquid precursors to the deposition chamber, maintaining the liquid precursor under the pressure of a neutral gas that may be very pure, accurately regulating the amount of precursors injected, and assuring stability in the deposition process over time. Pryor teaches that, in the art of depositing diamond films by a microwave plasma CVD process (i.e., a process analogous to that of Miyanaga et al.), carbon-containing precursors such as methanol or ethanol can be utilized, as well as mixtures thereof (Col.9, lines 3 – 20). In other words, Pryor teaches the functional equivalence of individual methanol and ethanol precursors (e.g., as suggested by Miyanaga et al.) and combined methanol / ethanol precursors for depositing diamond in a plasma enhanced CVD process. Therefore, it would have been obvious to one of ordinary skill in the art to utilize a mixed methanol / ethanol precursor mixture in the process of Miyanaga et al. with

the reasonable expectation of success and obtaining similar results when compared to utilizing either methanol or ethanol precursors individually.

10. The combination of Miyanaga et al., Senateur et al., and Pryor also teaches all the limitations of Claims 3, 5 – 7, and 9 – 18 as set forth above in paragraph 9 and below, including a method wherein:

    - Claim 3 – The methanol is present in the liquid precursor in an amount between about 0.5 wt.% and about 99.5 wt.% of the liquid precursor. While this limitation is not explicitly taught by the combination of references above, the examiner notes that the applicant's claimed range of methanol weight percentages is broad enough to encompass essentially all methanol weight percentages in a mixed liquid precursor composition. Therefore, absent any showing of criticality or unexpected results, it would have been obvious to one of ordinary skill in the art to utilize a methanol weight percentage in the applicant's claimed range with the reasonable expectation of success (i.e., successfully utilizing a mixed methanol precursor to deposit a diamond film).
    - Claim 5 – The carbon containing compound is selected from ethanol, isopropanol, acetone, and combinations thereof. Specifically, the combination of references suggests a methanol / ethanol precursor mixture (see paragraph 9 above).

- Claim 6 – The subjecting a vaporized precursor step is conducted at a pressure between about 1 mtorr and 250 torr (Col.5, lines 52 – 56 of Miyanaga et al., and/or Col.9, lines 44 – 47 of Pryor).
- Claim 7 – The substrate is heated to a temperature between about 300° C to about 1,600° C (Col.9, lines 13 – 15 of Pryor).
- Claim 9 – The substrate comprises a sheet or wafer of silicon, copper, aluminum, molybdenum, or alloys thereof. Specifically, Pryor suggests utilizing a silicon substrate (Col.3, lines 33 – 34).
- Claims 10 – 12 – The plasma is induced by electromagnetic energy, specifically microwave energy (Col.5 of Miyanaga et al., and/or Col.9, lines 54 – 56 of Pryor).
- Claim 13 – Please see paragraph 9 above for details. The examiner has established that it would have been obvious to one of ordinary skill in the art to utilize the process / device of Senateur et al. to deposit the diamond films of Miyanaga et al. / Pryor. The device of Senateur et al. has an inlet, disassociation zone (i.e., the plasma activation zone adjacent to the substrate as suggested by Senateur et al. – page 8, lines 1 – 4), deposition zone, and outlet as required by applicant's Claim 13 (see Figures 2 – 3 of Senateur et al., and the corresponding description). The liquid precursor is introduced into the inlet under conditions effective to vaporize the liquid precursor (page 7, lines 32 – 34, page 8, lines 1 – 4, and page 9, lines 14 – 24). The vaporized precursor is flowed through the

disassociation zone and through the outlet (page 7, lines 32 – 34, page 8, lines 1 – 4, and page 11, lines 1 – 22). The combination of Miyanaga et al., Senateur et al., and Pryor does not explicitly teach that the plasma produced in the "disassociation zone" contains OH, H, O, and carbon containing radicals, and that the carbon containing radicals produce the diamond film. However, the aforementioned combination of references teaches all of the applicant's claimed method steps, including the mixed methanol precursor, the processing conditions (i.e., temperature, pressure, microwave energy excitation), and the deposition of the diamond film from the plasma. Therefore, since the combination of references teaches the same precursors subjected to the same processing conditions to achieve the same end result (i.e., to deposit a diamond film) as that claimed and disclosed by the applicant, the process suggested by the prior art would have inherently produced the radical species claimed by the applicant and deposited the film from the carbon containing species as claimed by the applicant.

- Claim 14 – The disassociation step comprises passing the vaporized precursor through an electrical discharge zone for dissociating the precursor. Specifically, both Miyanaga et al. and Pryor suggest forming the plasma utilizing microwave energy (i.e., an electrical discharge).
- Claim 15 - The methanol is present in the liquid precursor in an amount between about 0.5 wt.% and about 99.5 wt.% (see Claim 3 above).

- Claims 16 – 17 – The methanol is supplemented with one or more carbon containing compounds containing carbon, hydrogen, and oxygen with the atomic ratio of carbon to oxygen greater than one (Claim 16), preferably ethanol, isopropanol, acetone, or combinations thereof (Claim 17) (see Claim 5 above).
- Claim 18 – The deposition zone is maintained at a temperature between about 200° C to 1600° C and at a pressure between 1 mtorr and 250 torr (see Claims 6 – 7 above).

11. Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Miyanaga et al. (USPN 5,626,922) in view of Senateur et al. (WO 95/02711) and Pryor (USPN 5,236,545), and in further view of Glesener et al. (USPN 5,381,755).
12. The combination of Miyanaga et al., Senateur et al., and Pryor teaches all the limitations of Claim 8 as set forth above in paragraphs 9 – 10, except for a method wherein the carbon containing compound (i.e., the precursor) includes a dopant element or moiety. However, Pryor teaches that diamond films such as the one produced by his invention are utilized in the fabrication of semiconductor devices (Abstract). Glesener et al. teach that doped diamond for semiconductor devices can be produced by CVD utilizing carbon-containing source gases, and that natural diamond is not useful for such electronic devices because of the inability to control the dopant level (Col.1, lines 8 – 49, and Cols.3 – 4). It is known to incorporate the dopant into one of the precursors used to deposit the diamond film (Cols.3 – 4).

Therefore, it would have been obvious to one of ordinary skill in the art to incorporate a dopant into the precursor of the combination of Miyanaga et al., Senateur et al., and Pryor with the reasonable expectation of successfully controlling the dopant level of the diamond film (e.g., a level which is taught by Glesener et al. to be an important parameter for semiconductor / electronic devices such as those disclosed in Pryor) and producing diamond films for semiconductor devices as suggested by Pryor.

Conclusion

13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Wesley D Markham whose telephone number is (703) 308-7557. The examiner can normally be reached on Monday - Friday, 8:00 AM to 4:30 PM.
14. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Shrive Beck can be reached on (703) 308-2333. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9310 for regular communications and (703) 872-9311 for After Final communications.
15. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

Wesley D Markham
Examiner
Art Unit 1762

WDM
June 24, 2002

SHRIVE P. BECK
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 1700